On the 28th low area XII developed marked intensity over the middle Mississippi Valley; during the 29th it moved northeastward over the upper Lakes, with high winds that extended over the middle Atlantic and New England coasts, heavy rains in Eastern and Southeastern States, and rain or snow in the Lake region. On the 30th barometric pressure below 29.00 inches attended the passage of the low area over the Canadian Maritime Provinces.

In advance of high area III the principal cold wave of the month swept from the Northwestern States to the Atlantic coast, carrying the line of freezing temperature southward to the middle Gulf coast, and causing light frost at Jacksonville, Fla., on the mornings of the 4th and 5th. On the 25th and 26th heavy frosts occurred on the Gulf coast and light frost at Jacksonville. In California the latter part of the month was cold, with snow in the mountains and frost in the citrus fruit districts.

On the 11th four inches of snow fell at El Paso, Tex.

BOSTON FORECAST DISTRICT.

Four well-defined storms, attended by moderate to heavy precipitation, and by gales along the coast, visited New England; the gale of the 10-11th wrecked the Nantucket lightship No. 58 which had weathered many great storms. Timely warnings alone prevented the loss of many staunch vessels during the month.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.

No severe windstorms occurred in the Gulf States and conditions did not justify cold-wave warnings. Frost warnings were issued on several dates, and the warnings were generally justified. Freezing temperature, for which timely warnings were issued, occurred in the sugar and trucking regions on the 4th and 5th.—*I. M. Cline, District Forecaster.*

LOUISVILLE FORECAST DISTRICT.

Several pronounced disturbances passed over the district. Cold-wave warnings were not issued or required.—*F. J. Walz, District Forecaster.*

CHICAGO FORECAST DISTRICT.

The month was exceptionally free from gales, the temperature continued mild, and but little rain or snow fell.

No warnings for general cold waves were issued, and warnings of heavy snow were not required.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.

In New Mexico the month was unusually cold, and in the southeastern part of that territorry heavy snow was a feature; elsewhere in the middle and southern Rocky Mountain districts the month was dry and cool. Several sharp falls in temperature, of a local character, occurred and warnings were issued on the morning of the 29th for a cold wave that visited northern Arizona.—*F. H. Brandenburg, District Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.

The month, as a whole, was one of deficient rainfall. Severe sandstorms occurred in the valleys of southern California on the 9th. The most important work of the month was in connection with the frost warnings.—*A. G. McAdie, Professor and District Forecaster.*

PORTLAND FORECAST DISTRICT.

No important storms occurred on the north Pacific coast until the 16-18th. On those dates, and on the 24th and 25th, 28th and 29th, severe weather attended the passage of barometric depressions from the Pacific.

Storm warnings were ordered in advance of the gales. Cold-wave warnings were not issued or required.—*A. B. Wollaber, Acting District Forecaster.*

RIVERS AND FLOODS.

The heavy rains of November 29 and December 3 caused a moderate flood in the Allegheny and Monongahela rivers. As a rule, danger-line stages were not quite reached, except at Pittsburg, where the crest stage on December 4 was 23.5 feet or 1.5 feet above the danger line. As usual, all interests were given timely warning, and no damage was reported.

The same general conditions produced a decided rise in the Ohio River without danger-line stages. No inconvenience resulted, except in the vicinity of Evansville, Ind., where the rising water necessitated the removal of a large amount of freight on the levee. Warnings of the rise were sent to Evansville on the 3d, and the crest stage of 32 feet was reached on the 9th.

The Missouri and upper Mississippi rivers were somewhat lower than during the preceding month, while the lower Mississippi rose from five to seven feet on account of the rise in the Ohio River and a supplementary rise out of the Red River. There were no high waters of consequence during the month, except in the Carolinas, where the heavy rains of the 21st were followed by moderate floods on the 22d and 23d, with stages as a rule somewhat above the danger lines.

Owing to the mildness of the season there was much less ice in the rivers at the end of the year than at the corresponding period of the year 1904, except in the extreme upper Missouri River, where the quantity was somewhat in excess of that of the previous year. The Mississippi was open below Leclaire, Iowa, and none of the eastern rivers, except those of northern New England, were closed.

The highest and lowest water, mean stage, and monthly range at 279 river stations are given in Table VI. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*

CLIMATE AND CROP SERVICE.

By Mr. JAMES BERRY, Chief of Climate and Crop Divison.

The following summaries relating to the general weather and crop conditions during December are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau; they are based upon reports from cooperative observers and crop correspondents, of whom there are about 3300 and 14,000, respectively:

Alabama.—The month, as a whole, was moderately cold, wet, and unfavorable for farm work; freezing temperatures prevailed on several dates; rains were frequent, but not damaging to land. Little progress was made in seeding oats and wheat, though the early sown made good growth. The little cotton outstanding at beginning of month was about all gathered by the 15th, after being damaged somewhat by wet weather. Late fall crops were all housed, with satisfactory yields.—*F. P. Chaffee.*

Arizona.—Temperature greatly deficient. Precipitation slightly below normal. There was an unusual depth of snowfall in the northern section. Plowing and seeding for winter wheat, barley, and oats progressed satisfactorily. Citrus fruits yielded largely; olive picking continued. Vegetables were abundant and growing well in the central and southern sections. Ranges were in excellent condition in the southern, and covered by snow in the northern counties. There was a bountiful supply of water; all river beds were full during the entire month.—*L. N. Jesunofsky.*

Arkansas.—Temperature decidedly below and precipitation slightly above the normal. The month was unfavorable for farm work on account of the cold, wet weather, and not much was accomplished. Wheat, oats, and rye made fair growth and did well. Late crops about all secured. Some cotton unpicked, but badly damaged as a result of the wet weather. Pastures still good and stock doing well. Fruit in fair condition.—*Chas. M. Strong.*

California.—Weather conditions during almost the entire month were unfavorable for agricultural interests. The temperature and precipitation were much below normal. Severe frosts near the end of the month

killed tender vegetation and caused some injury to unprotected citrus fruits in southern California. The loss to orange growers was minimized by ample warnings of the Weather Bureau. Severe sandstorms and high winds in the south damaged oranges to some extent. Rain at close of the month was beneficial.—*Alexander G. McAdie.*

Colorado.—Grazing was temporarily interrupted by snow in parts of Weld, Jefferson, and Rio Grande counties, and throughout the month in Garfield County; in other parts of the State the weather conditions were exceptionally favorable to live stock and grazing. Feeding had not become general by the close of the month. Cattle, horses, and sheep were reported to be in good condition on the ranges. In a few localities a scarcity of stock water was being felt.—*Frederick H. Brandenburg.*

Florida.—The temperature of the month was below normal, but the precipitation exceeded the normal by more than four inches. Excessive rains rendered low lands unfit for cultivation and destroyed many early vegetables in the southern district. The rainy weather caused some oranges to drop and delayed the work of harvesting the fruit. Early plantings of oats made good progress and sowing continued at the close of the month. Much replanting of vegetables will be necessary in the southern district.—*A. J. Mitchell.*

Georgia.—Abnormally low mean temperature, an unusual amount of cloudiness, and excessive rainfall characterized the December weather. Fall plowing and grain seeding were retarded by excessive moisture. Grains germinated to good stands and made rapid growth. No injury resulted from cold. Wheat acreage was increased in some sections. A considerable amount of fall plowing was done. Fruit trees were uninjured and in good condition. Stock was doing well.—*J. B. Marbury.*

Hawaii.—The month was showery in most sections of the group, with rather heavy rains in windward Hawaii and windward Maui; abnormally low temperatures were general during the second decade. Young cane grew slowly and suffered considerable damage in many localities from high winds during the second week. Conditions were, on the whole, rather favorable for field operations, and grinding of 1906 cane became general by the close of the month. Ripening of winter pineapples was retarded by cool and partly cloudy weather. Coffee picking continued all the month and was practically completed in leeward Hawaii. Harvesting of winter rice was completed early in the month; this was followed by general plowing of rice patches. The showery conditions were quite favorable for pasture lands. Sisal grew well.—*Alex. McC. Ashley.*

Idaho.—The month was characterized by continuously cold weather, though no extremely low temperatures were experienced. There was a good snow covering on winter wheat fields, and fruit and shade trees were believed to be in good condition. More than the usual amount of snow lay on the winter ranges, but there was sufficient feed and stock was in good condition.—*Edward L. Wells.*

Illinois.—The condition of wheat continued excellent, notwithstanding deficiency in moisture and some alternate freezing and thawing, and its chief requirement at end of month was a covering of snow. Husking, cribbing, and shelling of corn continued, the crop being mostly garnered by the 15th. In localities where apples were gathered the fruit, owing to inferior quality, was not keeping well. Potatoes were rotting badly and a general shortage was reported.—*Wm. G. Burns.*

Indiana.—Wheat, rye, timothy, and young clover were generally in excellent condition, though, owing to absence of snow protection, they suffered slightly from freezing and thawing; too much rain was also slightly detrimental to these crops on southern lowlands. Much old clover appeared to be dead. Tobacco was being stripped and marketed. Corn gathering was practically finished. Stalk fields and pastures afforded sufficient feed for grazing stock until near the end of month, when some feeding became necessary in the northern and central sections.—*W. T. Blythe.*

Iowa.—December was one of the fairest winter months ever known in this State, the temperature being above and the precipitation below normal. There were no severe storms and the average number of clear days was 19. Conditions were unusually favorable for completing corn gathering, and farm stock was grazing in the fields nearly every day. Winter wheat and rye showed no damage from freezing,—*John R. Sage.*

Kansas.—The month was dry, but the ground continued moist. Wheat was in good condition. Corn was nearly all cribbed. Spring plowing progressed in the southern part of the State. The range was good and cattle were in good condition. There was but little wind.—*T. B. Jennings.*

Kentucky.—The weather was favorable to winter crops, with no severe freezing weather or cold waves, though rainfall was excessive on the 2–3d. Several rainstorms occurred the later half of month, with snow and sleet on the 15th and gales on the 28–29th. Wheat appeared very promising at close of month, though some little damage resulted from alternate freezing and thawing. Fall sown grasses suffered somewhat from like cause. Pastures remained good and stock was in excellent condition for winter. Winter oats and rye were well advanced.—*F. J. Walz.*

Louisiana.—Frequent rains during the month retarded agricultural operations. Very little progress was made in preparing for spring crops, except in scattered localities. Oats and rye made good growth. Sugar harvest was materially interfered with by rains and, as a result of unfavorable weather and the heavy tonnage in some sections, grinding will not be completed on some plantations until in February. Winter gardens made fairly good growth.—*I. M. Cline.*

Maryland and Delaware.—December was a month of mild temperature and an ample amount of precipitation, both being considerably above normal. The only cold wave of any consequence was that of the 18th and 19th, and this was confined to western counties and did no damage, owing to the protection afforded by several inches of snow on the ground. Wheat and grasses improved greatly and were in excellent condition at the close of the month. Plowing for spring sowing was commenced.—*C. F. von Herrmann.*

Michigan.—The weather conditions during December were generally favorable to winter wheat and rye. The soil was quite dry and the ground generally bare of snow during the first two decades; ample moisture and a partial snow blanket obtained during the last ten days of the month. Wheat and rye made very little winter growth, but were generally in good condition at the close of the month; both seedings showed generally good, healthy stands.—*C. F. Schneider.*

Minnesota.—The monthly mean temperature was considerably above normal. The precipitation, which was all snow, was much below normal. The snow depth ranged from 3 inches in south to 15 inches in north early in the month, but gradually diminished. Work in the lumber regions was delayed by poor roads, as the swamps were not frozen hard before snow fell. The usual winter farm work was pursued. Building work experienced little interruption.—*T. S. Outram.*

Mississippi.—Excepting fairly favorable conditions during the first decade, when cotton picking was practically completed, much cloudy, rainy weather prevailed, which materially hindered preparations for the coming season. The soil was generally too wet for plowing. Very little seeding was done. Although the mean temperature was much below normal, there was no severe cold weather. Numerous heavy frosts occurred to the coast line.—*W. S. Belden.*

Missouri.—Although the weather during December was but little warmer than the normal, the temperature was remarkably uniform, which, together with a light rainfall and high percentage of sunshine, made it an unusually pleasant winter month. There were no severe storms or cold waves. The weather conditions were generally favorable for winter wheat; in a few south-central counties slight damage was reported as a result of alternate freezing and thawing, but the crop as a whole was in good condition. The cribbing of corn was completed.—*George Reeder.*

Montana.—Uniformly mild temperatures and absence of heavy snows made the month unusually favorable for stock. November snow remained in some western counties and became crusted on the ranges. Ranges were open and in good condition throughout the month in the eastern counties. Cattle, sheep, and horses were mostly wintering well, with little loss so far. In the principal wheat growing counties the fields were covered with several inches of snow till the close of the month, and all grain that germinated in the fall was in good condition.—*R. F. Young.*

Nebraska.—The dry weather and moderate temperature of the month allowed rapid progress to be made with corn husking, and most of the corn was secured before the end of the month. Winter wheat and rye retained a green color throughout the month and were generally a fine stand. Winter wheat was somewhat above average in condition. The month was very favorable for stock interests, with no storms or severe weather.—*G. A. Loveland.*

Nevada.—The temperature was 8° below normal, and the lowest in seventeen years; there was a marked deficiency in every section of the State. The precipitation was 1.28 inches below normal in the western section, and slightly below elsewhere. Stock and beef cattle and mutton sheep fed on ranches made the desired gains; range stock was generally in fair condition, but began to suffer in some localities from the extended cold weather.—*H. F. Alps.*

New England.—The weather was exceptionally pleasant, considering the season, precipitation occurring on an average of only eight days. Notwithstanding the few days with rain or snow, the average precipitation was somewhat above the normal. The weather was very favorable to outdoor work, although more snow was needed for successful logging. Generally speaking, there was little frost in the ground at close of month. Stock was wintering very well.—*J. W. Smith.*

New Jersey.—The month was noted for its exceptionally mild temperature and well distributed rains. Plowing was possible almost every day in the southern section. Early sown wheat, rye, and meadows were very much improved by the rains, but the late sown wheat showed a poor stand and was thin on the ground. Frequent freezing and thawing did no injury. The snowfall was very light in all sections.—*Edward W. McGann.*

New Mexico.—December was a very cold month, averaging for the Territory nearly 4° below the normal. The precipitation was above the average, except in the extreme northern portion. The snowfall over the plains and in the mountain districts of the central portion was remarkably heavy, and at the end of the month the snow varied in depth over the plains from six inches to three feet and in the mountains from three to eight feet. Range grass was plentiful; stock remained in good condition and no losses were reported.—*J. B. Sloan.*

New York.—The weather averaged unusually mild and pleasant for

SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS, DECEMBER, 1905.

In the following table are given, for the various sections of the Climate and Crop Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Section.	Temperature—in degrees Fahrenheit.							Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes.					Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest. Date.			Station.	Amount.	Station.	Amount.
Alabama	43.7	— 2.5	Daphne, Wetumpka.	75	22	Riverton	14 4	6.46	+2.14	Opelika	11.72	Thomasville	2.96
Arizona	41.9	— 3.6	Parker	77	21	Fort Defiance	—20 23	1.55	—0.06	Nutrioso	4.11	Aztec	0.20
			Vail	77	14								
Arkansas	38.5	— 3.7	Bee Branch	70	8	Oregon	7 4	4.96	+0.84	Howe	7.80	Silver Springs	1.70
California	45.3	— 1.9	Escondido	90	7	Bodie	—21 23	1.55	—2.43	Monumental	11.86	7 stations	0.00
Colorado	22.1	— 2.9	Trinidad	68	16	Gunnison	—46 23	0.20	—0.57	Hahns Peak	1.31	11 stations	0.00
Florida	58.0	— 1.3	Avon Park	90	21	Madison	23 21	7.50	+4.64	Jupiter	15.18	St. Augustine	3.33
			Caxambas	90	3	Middleburg	23 11						
Georgia	44.5	— 2.3	Fleming	81	22	Diamond	13 11	8.56	+4.48	Quitman	11.60	Carrollton	3.40
Hawaii	†69.5	.....	Olaa Mill, Hawaii	91	3, 19	2 stations	46 13, 24	‡6.13	.....	Nahiku, Maui	25.51	Kekaha, Kauai	0.04
Idaho	24.5	.....	Oakley	60	17	Chesterfield	—22 28	1.32	.....	Hope	3.95	Lost River	0.10
Illinois	31.4	+ 1.6	4 stations	60	7, 11	Martinton	— 3 24	1.99	—0.27	Raum	4.53	Zion	0.44
Indiana	32.8	+ 0.9	Bloomington	63	26	Logansport	— 1 24	2.42	—0.43	Jeffersonville	5.58	Markle	0.81
Iowa	27.0	+ 4.0	Jefferson	62	8	Monticello	—11 23, 24	0.52	—0.73	Ottumwa	1.69	2 stations	T.
Kansas	33.0	+ 0.1	Valley Falls	67	11	Norton	2 3	0.18	—0.87	Columbus	1.53	9 stations	0.00
						Wallace	2 31						
Kentucky	37.3	+ 0.3	Burnside	66	27	Greensburg	11 25	4.38	+0.58	Alpha	6.12	West Liberty	2.00
Louisiana	46.6	— 4.9	Schriever	79	2	Ruston	19 5	5.91	+1.46	New Orleans	14.43	Lakeside	2.54
Maryland and Delaware	36.6	+ 1.9	Millsboro, Del	64	3	Frederick, Md	2 18	4.36	+1.14	Millsboro, Del	6.21	Deer Park, Md	2.41
Michigan	28.4	+ 3.2	Bloomingdale	60	7	Humboldt	—26 14	1.58	—0.76	Ishpeming	3.70	Menominee	0.15
			Coldwater	60	27								
Minnesota	20.6	+ 4.7	Amboy, Windom	55	26	Park Rapids	—22 1	0.15	—0.62	Caledonia	0.96	3 stations	0.00
Mississippi	43.4	— 4.6	Quitman	75	22	4 stations	18 5, 6	5.64	+0.91	Pearlington	14.34	Canton	3.49
Missouri	33.3	+ 0.3	Arthur	66	7	Unionville	— 2 24	1.45	—0.74	New Madrid	5.02	Rockport	T.
Montana	23.9	— 0.1	St. Pauls	61	15	Grayling	—36 22	0.25	—0.52	Columbia Falls	2.79	7 stations	0.00
Nebraska	29.9	+ 2.4	Bartley	65	12	Hay Springs	—14 3	0.02	—0.53	2 stations	0.20	50 stations	0.00
Nevada	22.5	— 8.0	Martins Ranch	68	4	Potts	—21 23	0.60	—0.43	Eureka	1.60	McAfees Ranch	0.00
New England*	28.6	+ 2.1	Norfolk, Mass	62	3	Enosburg Falls, Vt.	—28 15	3.59	+0.43	Bar Harbor, Me	7.61	Oquossoc, Me	1.47
						Van Buren, Me	—28 12						
New Jersey	36.3	+ 2.5	6 stations	61	3, 29	Layton	5 18	3.65	—0.07	Woodbine	5.60	River Vale	2.58
New Mexico	29.7	— 3.9	Fort Union	73	16	Datil	—18 23	1.04	+0.05	Laguna	5.54	Dorsey	0.00
New York	29.7	+ 2.7	Indian Lake	65	30	Paul Smiths	—27 15	3.07	+0.16	Adams Center	7.32	West Berne	0.56
North Carolina	41.5	— 0.7	Nashville	76	21	Buck Spring	0 4	6.98	+3.16	Southport	11.93	Buck Spring	4.57
North Dakota	15.6	+ 3.0	Oakdale	55	15	Pratt	—34 4	0.16	—0.33	Hamilton, Walhalla	1.10	10 stations	T.
Ohio	32.9	+ 1.9	Findlay	58	8	Hudson	2 1	2.25	—0.55	Pulse	4.09	Dayton (2)	1.10
			Ironton	58	12								
Oklahoma and Indian Territories.	38.0	— 1.4	Chattanooga	80	1	3 stations	9 3 dates	1.26	—0.40	Ravia	3.64	Kenton	T.
Oregon	36.2	— 1.6	Port Orford	64	11	Burns	—10 21	4.98	—1.22	Glenora	24.48	Silver Lake	0.07
						Granite	—10 3 d't's						
Pennsylvania	33.6	+ 2.8	Philadelphia (c)	65	3	Saegerstown	— 5 1	3.57	+0.26	Uniontown	5.48	Erie	0.95
Porto Rico	74.8	.....	3 stations	92	3 dates	Adjuntas	49 8	2.89	.....	Caguas	7.08	Hac. Coloso	0.15
South Carolina	45.2	— 2.1	Walterboro	77	23	Greenville	16 3 dates	7.25	+3.96	Chappels	11.18	Kingstree	3.18
South Dakota	23.9	+ 3.4	Dallas	67	7, 15	Kidder	—22 1	0.04	—0.56	Clark	0.45	5 stations	0.00
						White Horse	—22 3						
Tennessee	39.1	— 1.3	Iron City	67	22	Hohenwald, Rugby	9 5	4.98	+0.80	Isabella	9.18	Brownsville	2.90
Texas	43.9	— 5.5	Fort Ringgold	86	8	Texline	7 29	3.62	+1.47	Jefferson	10.53	Texline	0.00
Utah	22.8	— 5.3	Rockville	63	15	Strawberry Valley	—32 10	0.62	—0.42	Payson	2.30	3 stations	T.
Virginia	37.7	— 0.4	3 stations	68	21, 23	Lincoln	3 18	5.10	+2.09	Dinwiddie	8.24	Marion	3.21
Washington	34.5	+ 0.2	Coupeville	60	4	Cusick	— 4 31	4.04	—1.28	Clearwater	20.11	Sunnyside	0.37
West Virginia	35.6	+ 1.4	Charleston	70	2	Bayard	3 1	3.11	+0.17	Cairo	5.24	Creston	1.30
			Logan	70	27								
Wisconsin	24.1	+ 4.3	Appleton	56	9	Grantsburg	—24 6	1.04	—0.34	Sturgeon Bay	2.66	Grantsburg	T.
Wyoming	19.5	— 3.3	Chugwater	65	16	Norris Geyser Basin	—30 22	0.40	—0.51	Grand Can., Y.N.P.	1.75	3 stations	0.00
						Thumb, Y.N.P.	—30 22						

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. † 49 stations, with an average elevation of 636 feet. ‡ 133 stations.

December. The temperature was generally above normal, except from the 14th to 16th, which was the coldest period of the month. The precipitation was slightly above normal, but the snowfall was very light, except in the Adirondack region. Winter grains appeared to be in fairly good condition, and stock was wintering well. There was very little sleighing, and practically no ice had been harvested thus far.—*W. C. Devereaux.*

North Carolina.—The weather was not favorable for outdoor work, owing to the excessive precipitation, but the rains were greatly needed and were very beneficial to fall sown grain, which was very backward owing to the preceding dry weather. In some localities the rains were so heavy as to do considerable damage to crops by washing. No severe freezing weather occurred during the month, and there were no reports of damage to truck crops under glass. Lettuce did exceptionally well.—*A. H. Thiessen.*

North Dakota.—The month was generally mild and pleasant, with but very light snowfall, which allowed stock on the ranges to graze the entire month, while there was sufficient snow on the ground to satisfy their thirst.—*B. H. Bronson.*

Ohio.—December was warmer than the normal and there was less rainfall than usual. The weather was generally pleasant and favorable for farm work. There was very little snow protection over the fields, yet the weather was so mild that neither grass nor grain fields suffered to any marked extent. Wheat and rye were in fair condition at the close of the month. Corn husking was carried on rapidly, and some plowing was done. Tobacco stripping progressed well.—*J. Warren Smith.*

Oklahoma and Indian Territories.—The temperature was slightly below normal. The rainfall was deficient, but ample for present requirements. Weather favorable for gathering outstanding crops and for plowing, and considerable progress was made. Wheat was in good condition and was being pastured; some late planted showed a thin stand. Cotton was about all picked; lint of good quality. Ample forage crops secured to provide winter feed. Range fairly good and stock doing well; some being fed. Fruit trees uninjured.—*J. P. Slaughter.*

Oregon.—The bulk of the wheat was unprotected by snow at the end of the month. Considerable freezing and thawing weather occurred, but as there were no severe cold spells, the crop was not harmed. Except in the colder sections, where growth was at a standstill, fall wheat had a thrifty appearance. Pasturage was poorer than last year, and more than the usual amount of extra feeding of stock was necessary.—*Edward A. Beals.*

Pennsylvania.—December weather conditions were unusually favorable for outdoor work and the growth of grain and grass. The month closed with soil thoroughly saturated and bare of snow. Winter grain reported

well set and thrifty, and but few fields were injured by lack of snow protection.—*T. F. Townsend.*

Porto Rico.—The rainfall was considerably below normal in most districts. Dry weather was favorable for the older canes, but detrimental to the newly planted. Sugar-making began in the south during the middle of the month; grade of juice below normal. In the north and east canes were not sufficiently matured for grinding. Sowing and transplanting of tobacco was active and general and the crop was doing well. October sowings were cut; yield average, with a good per cent of wrappers. Coffee picking continued in the highlands. Oranges abundant. Small crops scarce in places. Pastures and cattle in good condition.—*E. C. Thompson.*

South Carolina.—Although the mean temperature was below normal, there was little freezing weather, a condition favorable for the germination of wheat and oats, which attained good stands. The precipitation was excessive, which interfered with plowing and seeding. The weather conditions were favorable for winter truck in the coast truck regions, and it was in a promising stage of growth. Over the greater portion of the State the ground was thoroughly saturated, and streams had more than their normal flow of water.—*J. W. Bauer.*

South Dakota.—The month was warmer than usual, with very little precipitation. Live stock did well and was in good winter condition, but in some northern counties November snow remaining on the ground hindered grazing on the ranges part of the month and necessitated more than the usual feeding from stack. In some southern counties absence of snow covering part of the month was considered unfavorable for winter grains, though no special injury was apparent. The month closed with very little corn in the fields.—*S. W. Glenn.*

Tennessee.—The weather was generally favorable to winter grains. There was no serious damage from freezing. The rainfall was ample, being considerably more than the normal in the eastern section. At the end of the month wheat, oats, and rye were in good condition, with fine stands as a rule. Pastures were better than usual at this period. Fairly good progress was made in plowing and in other farm work of the season.—*H. C. Bate.*

Texas.—Cool weather prevailed during the greater part of the month. Killing frost occurred frequently over the interior and extended to the coast line on the 25th. Beneficial rains occurred during the month, putting the ground in good condition. Plowing, seeding, and cotton picking were somewhat delayed and unpicked cotton was considerably damaged. Small grains generally did well. Rice thrashing and cane grinding were completed, except in a few localities. Truck gardens were not doing well. Range and stock were in fair condition.—*E. E. Spencer.*

Utah.—Temperatures during the month were abnormally low. Precipitation, which was almost entirely in the form of snow, was deficient over the valleys, but above average in the mountains and more elevated portions of the section. Fall wheat was in very good condition and well protected by an ample covering of snow. Stock, though being fed in many localities, was thriving.—*R. J. Hyatt.*

Virginia.—The general weather conditions of the month were quite favorable for work in the field, as well as for the growth of winter crops. Wheat, oats, and clover did well, on the whole, while rye and barley advanced sufficiently to afford grazing for stock. Considerable plowing was done and much work in the way of gathering, housing, and husking corn was completed. Moderate cold spells caused some light freezing and thawing, but no damage resulted.—*Edward A. Evans.*

Washington.—The fore part of the month was unusually dry, except near the coast, but the last decade was wet, especially in the western section. There was snow at the end of the month throughout the eastern section. The weather was favorable for winter wheat, which was in good condition, although not so well advanced as usual when snow came and covered it at the end of the month.—*G. N. Salisbury.*

West Virginia.—On the whole the weather was exceptionally fine during the month. There were good rains and considerable freezing weather. Stock was in good condition and there was plenty of feed on hand. Early sown wheat was looking well, but late sown was somewhat injured, as there was practically no protection afforded by snow. Little farm work was done.—*E. C. Vose.*

Wisconsin.—The temperature during the month averaged considerably above the normal, although some stations in the northern section reported temperatures ranging from zero to 24° below during the second and third decades. The precipitation, which was a little below the normal, was fairly well distributed. It was generally in the form of snow, which afforded a fair protection to winter grains during the periods of severe cold. No weather conditions of an abnormal character were reported, and the general situation was satisfactory.—*H. B. Hersey.*

Wyoming.—The fall months were unusually favorable for the stock interests of the State, and the close of the year found stock in excellent condition; ranges still afforded good feed, and hay was plentiful. The supply of snow in the mountains was not up to the average for the season, but there was more than at the close of 1904.—*W. S. Palmer.*

SPECIAL ARTICLES.

DOCTOR MARGULES ON THE ENERGY OF STORMS.

By Dr. S. TETSU TAMURA. Dated Washington, December, 1905.

Dr. Max Margules, of Vienna, has enriched theoretical meteorology by an exceedingly suggestive and important memoir on "The energy of storms,"[1] published during 1905, as an appendix to the Yearbook of the Central Meteorological and Geodynamical Institute of Vienna, for the year 1903. The paper consists of two parts. The first part, which covers only four pages, is an excellent summary of his ideas on the energy of storms for the nonmathematical reader. The second part, which covers 22 pages, embodies the elegant mathematical analysis, by which he attained the ideas popularly expounded in the first part.

It may be easily seen that the kinetic energy of a kilogram of air moving with the speed of 30 meters per second is 450 units (kg. m² sec.$^{-2}$) and nearly equal to 0.1 calorie. This quantity, which is not large in comparison with the quantity of heat that a kilogram of air at the earth's surface receives and loses in one day, appears very large when the energy of a kilogram of air moving with the average velocity (say five meters per second) is taken as a unit of measure. It is not probable that a much larger part of the heat communicated to the air at the time of a storm is converted into kinetic energy. Hence there arises the important question, "What is that condition of the atmosphere in which a sufficiently large quantity of kinetic energy can be accumulated in order to produce a storm?"

The first task of Doctor Margules was to construct the *fundamental energy equations of a moving particle and a mass of air in a closed system.* From one of the equations of atmospheric motions relative to moving axes, Doctor Margules formed the following equation[2] of the kinetic energy of a unit mass of air,

$$\frac{d}{dt}\left(\frac{c^2}{2}+W\right)+\frac{1}{\mu}\left(\frac{dp}{dt}-\frac{\partial p}{\partial t}\right)-Rc\cos(R,c)=0. \qquad (1)$$

From this equation, together with the thermodynamic equation,

$$\frac{dQ}{dt}=c_p\frac{dT}{dt}-\frac{1}{\mu}\frac{dp}{dt} \qquad (2)$$

where dQ means an increase of the quantity of heat in a particle of air moving over the distance ds in the time dt, the following energy equation of a moving particle of air is obtained:

$$\frac{dQ}{dt}=c_p\frac{dT}{dt}+\frac{d}{dt}\left(\frac{c^2}{2}+W\right)-\frac{1}{\mu}\frac{\partial p}{\partial t}-Rc\cos(R,c) \qquad (3)$$

for the whole mass for a closed system.

The above equations must be integrated. The equation for kinetic energy thus obtained is

$$\frac{\partial}{\partial t}\int\left(\mu\frac{c^2}{2}+\mu W\right)dk+\int\frac{p}{\mu}\frac{d\mu}{dt}dk-\int Rc\cos(R,c)\,\mu dk=0. \qquad (4)$$

The thermic equation for the entire mass in the closed system becomes

$$\int\frac{dQ}{dt}\mu dk+c_v\frac{\partial}{\partial t}\int T\mu dk-\int\frac{p}{\mu}\frac{d\mu}{dt}dk. \qquad (5)$$

Finally the author obtained the energy equation of the air mass in the closed system as follows:

$$\int\frac{dQ}{dt}\mu dk=c_v\frac{\partial}{\partial t}\int T\mu dk+\frac{\partial}{\partial t}\int\left(\mu\frac{c^2}{2}+\mu W\right)dk-\int Rc\cos(Rc)\mu dk. \qquad (6)$$

[1] Ueber die Energie du Stürme.

[2] The notation is $W=$ the potential due to gravitation and the centrifugal force of the earth's rotation; c the velocity of the air; μ the density; p the pressure; R the resisting force of friction; T the absolute temperature; c_p the specific heat at constant pressure; c_v the specific heat at constant volume; k the volume of the closed system.